Case Studies and Regression Analysis

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Examples of Strengths and Weaknesses

Case Selection

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1. Study the entire population.

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2. Take a random sample.

Case Selection

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2. Take a random sample.
3. Follow some rule for deliberate case selection.

Mill's Methods

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- Method of Agreement

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- Method of Difference

Mill's Methods

- Method of Agreement
- Method of Difference
- Etc..

Crucial Cases

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- Theory assigns high likelihood to an outcome in a particular case that, for (all, or most, or a major) competing theory has low likelihood.

Regression Analysis

- In a survey of 1000 articles in 10 leading political science journals, 49% used statistics (Bennett, Barth, and Rutherford 2003).
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- In a survey of 1000 articles in 10 leading political science journals, 49% used statistics (Bennett, Barth, and Rutherford 2003).
  - Presumably, most of them involve some variant of regression.
- A search in JStor for the word "regression" finds 10,404 relevant articles.

Regression Analysis

- Almost no matter what you work on, you will have to interact with regression-based studies.

Choosing Cases

- Case-selection rules:

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  - Random sampling

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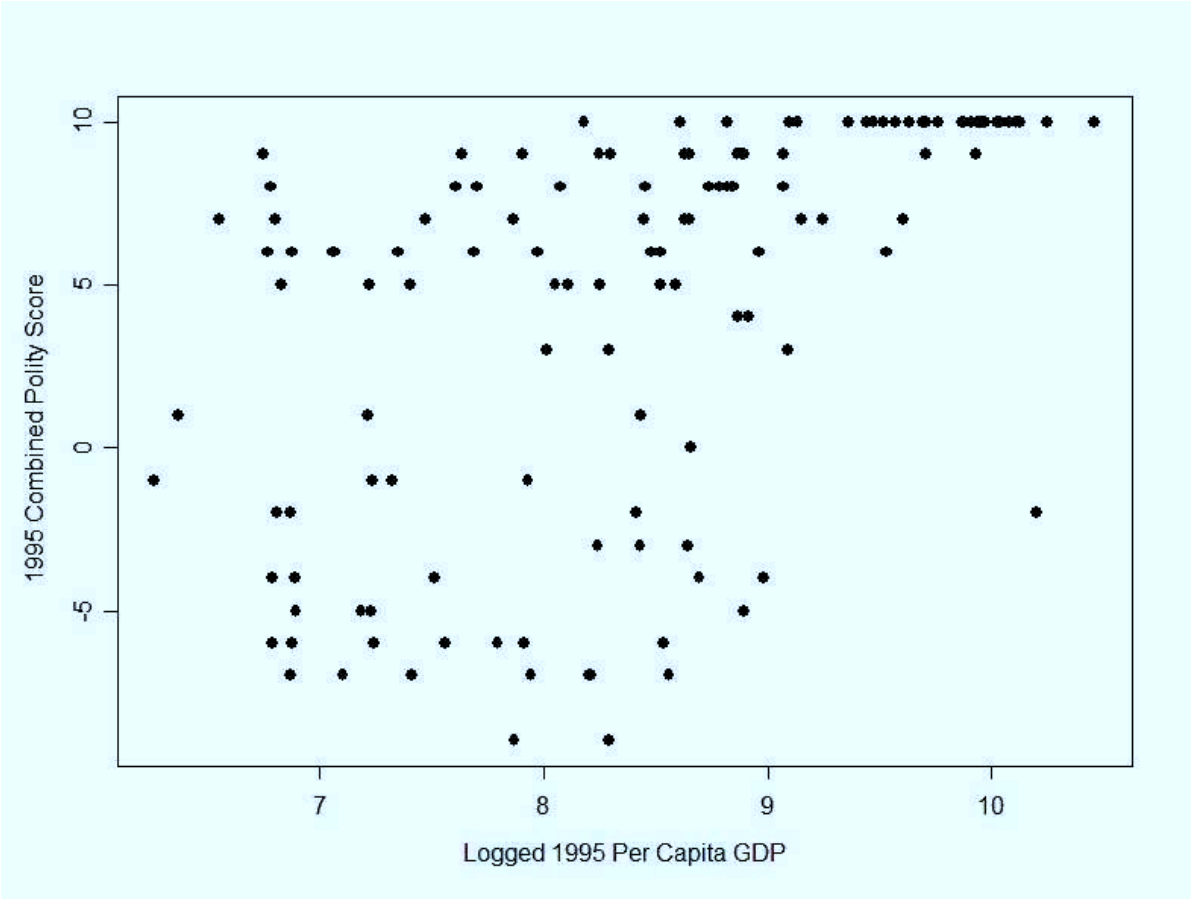
  - Extreme cases
  - Deviant cases
  - Influential cases
  - Most-similar cases

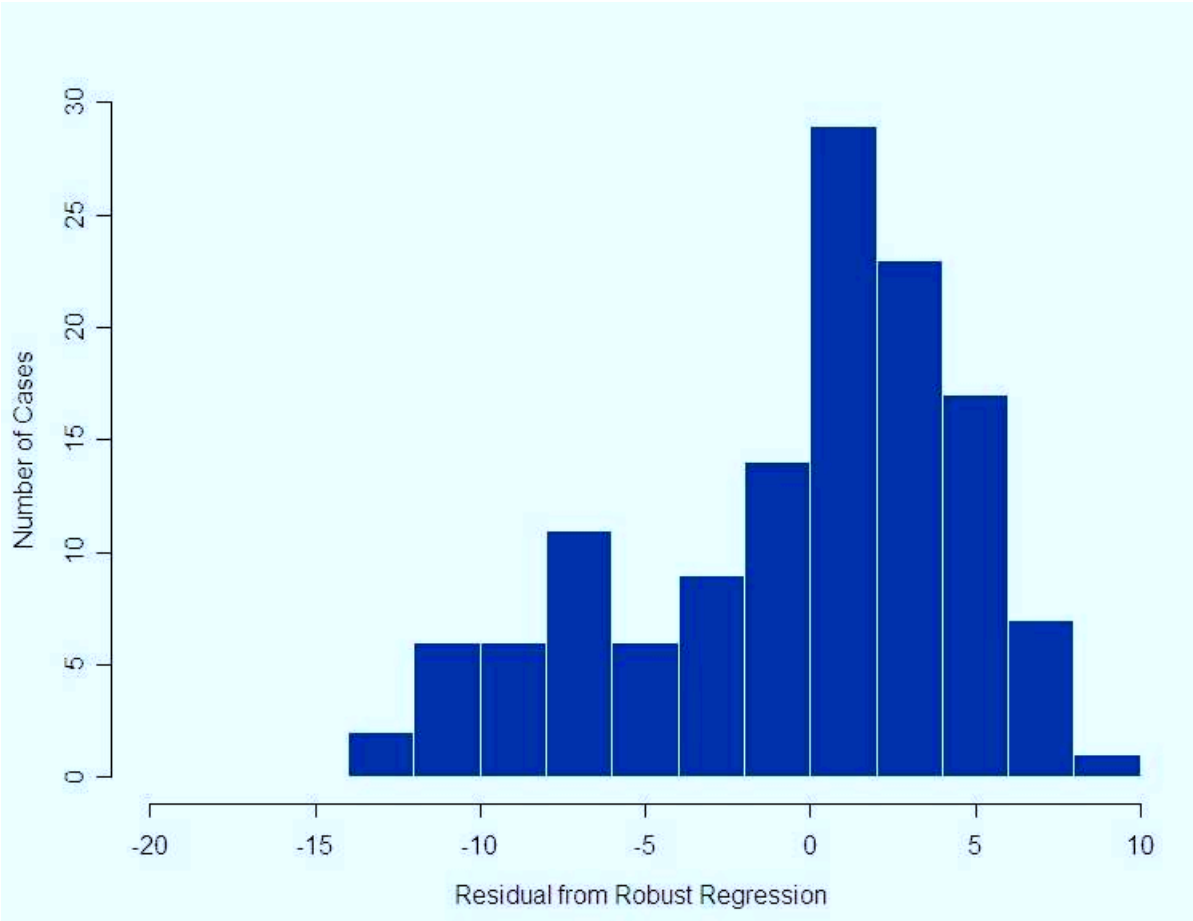
Running Example



Typical Cases

$$\text{Typicality}_i = -\text{abs}[y_i - \text{E}(y_i|x_{1,i}, x_{2,i}, \ldots, x_{k,i})] \quad (1)$$

Typical Cases



Extreme Cases

$$\text{Extremity}_i = |\frac{x_i - \bar{x}}{s}| \tag{2}$$

Deviant Cases

$$\text{Deviantness}_i = -\text{Typicality}_i \tag{3}$$

Influential Cases

- Cook's distance is a statistical measure of how much the overall regression result would change if a given case is deleted.

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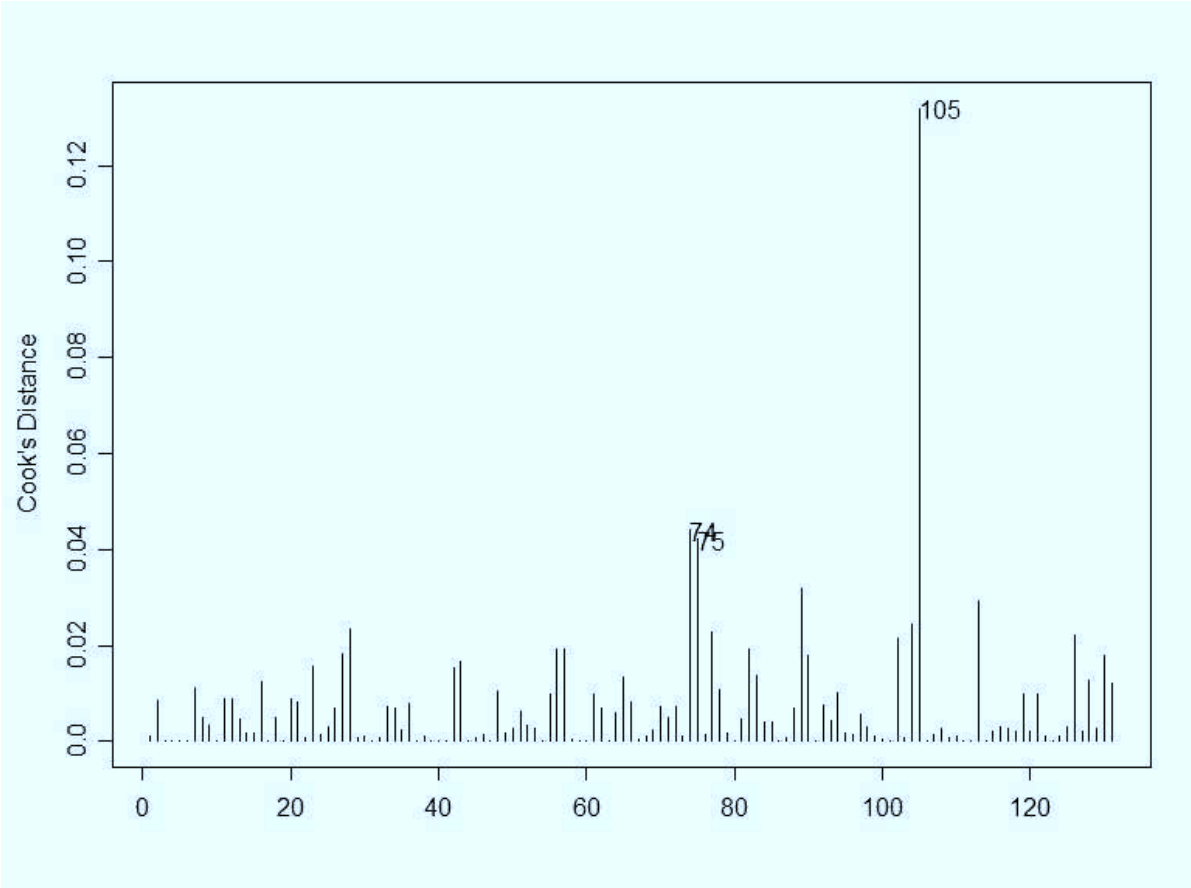
- A Cook's distance score of 1 or more usually is regarded as representing substantial influence.

Influential Cases



Most-Similar Cases

- Matching techniques are an automated way of finding most similar cases.

Measurement Error in Y

$$Y_i^* = Y_i + \delta_{Y,i}$$

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Random Sampling

Measurement Error in Y

Typical/Deviant Cases:

$$e_i = Y_i - \mathbb{H}_{i,.} Y + \delta_{Y,i}$$

Measurement Error in Y

Influential Cases Strategy:
Maximizes the product of the error term and the weighted average distance of the right-hand-side variables from their means.

Measurement Error in Y

Extreme Cases:

$$Y_i^* = Y_i + \delta_{Y,i}$$

Measurement Error in Y

Most-Similar Cases

Measurement Error in Y

Most-Similar Cases

Most-Different Cases

Measurement Error in X

$$X_i^* = X_i + \delta_{X,i}$$

Measurement Error in X

$$X_i^* = X_i + \delta_{X,i}$$

Random Sampling

Measurement Error in X

Typical/Deviant Cases:

$$e_i = Y_i - X_i\hat{\beta}^* - \delta_{X,i}\hat{\beta}^*$$

Measurement Error in X

Influential Cases Strategy:
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Measurement Error in X

Extreme Cases:

$$X_i^* = X_i + \delta_{X,i}$$

Measurement Error in X

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Measurement Error in X

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Most-Different Cases

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$$e_i = d_i + \gamma \tilde{Z}_i, \text{ where } \tilde{Z}_i = Z_I - \mathrm{E}(Z_i|X_i)$$

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$\hat{Y}_i + d_i + \gamma \tilde{Z}_i$

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Pathway Variables

$$W_i = \nu + \mu X_i + \omega_i$$
$$Y_i = \alpha + \tau W_i + \sigma_i$$

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Pathway Variables

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$e_i = \tau\omega_i + \sigma_i$

Pathway Variables

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Pathway Variables

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Summary: Analytic Arguments

	Deviant	Influential	Ext. X	Ext. Y
Error in Y	Good	Mixed	Poor	Good
Error in X	Mixed	Mixed	Good	Poor
Confound	Good	Mixed	Mixed	Good
Pathway	Good	Mixed	Good	Mixed

Monte Carlo for Case Selection

Simulate case selection for the same problem 10,000 times.

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- Add measurement error, omitted variables, etc.
- 2 SD Rule

Simulation Results

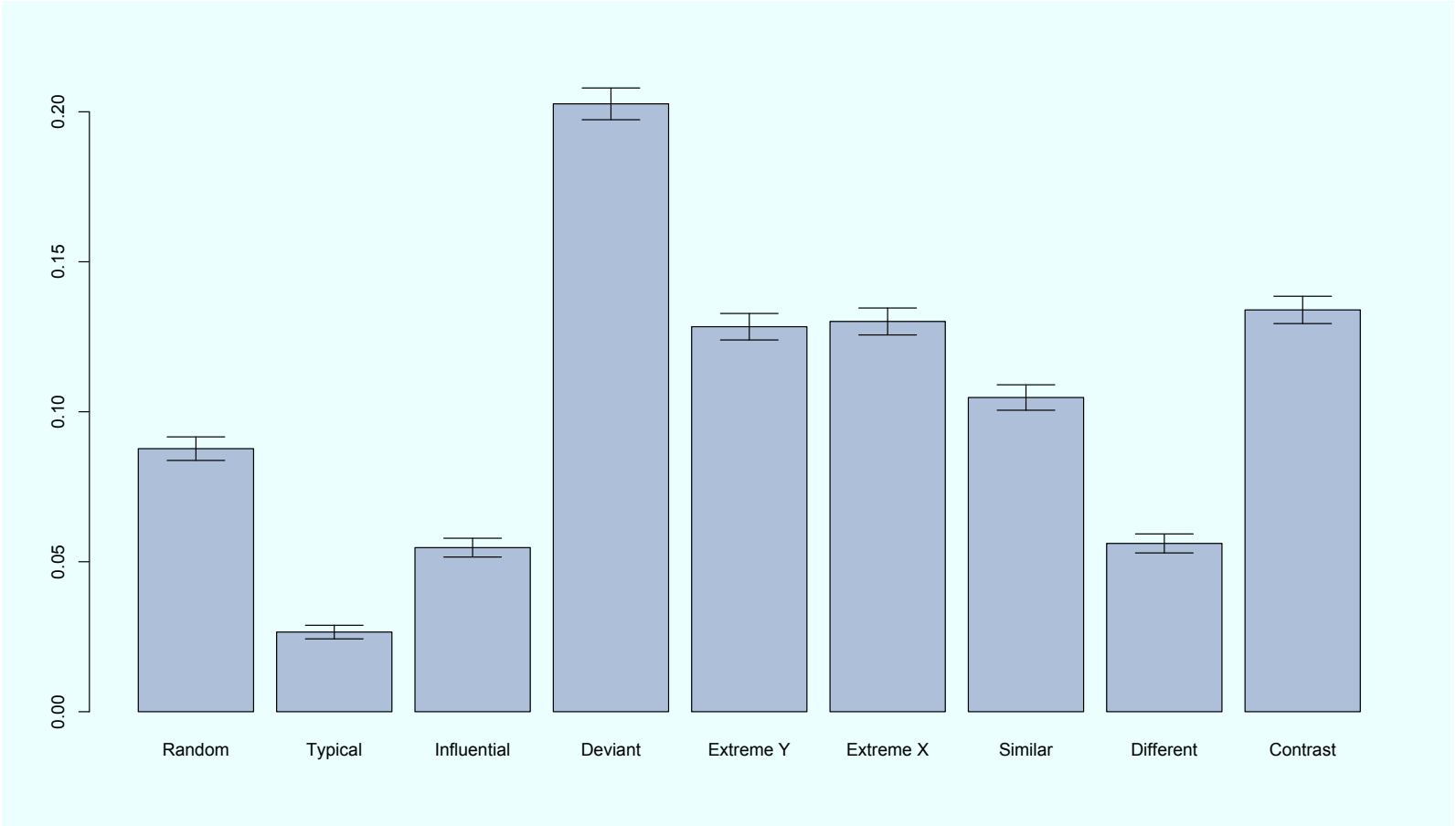

Figure: Case Selection for Finding Confounder.

Simulation Results

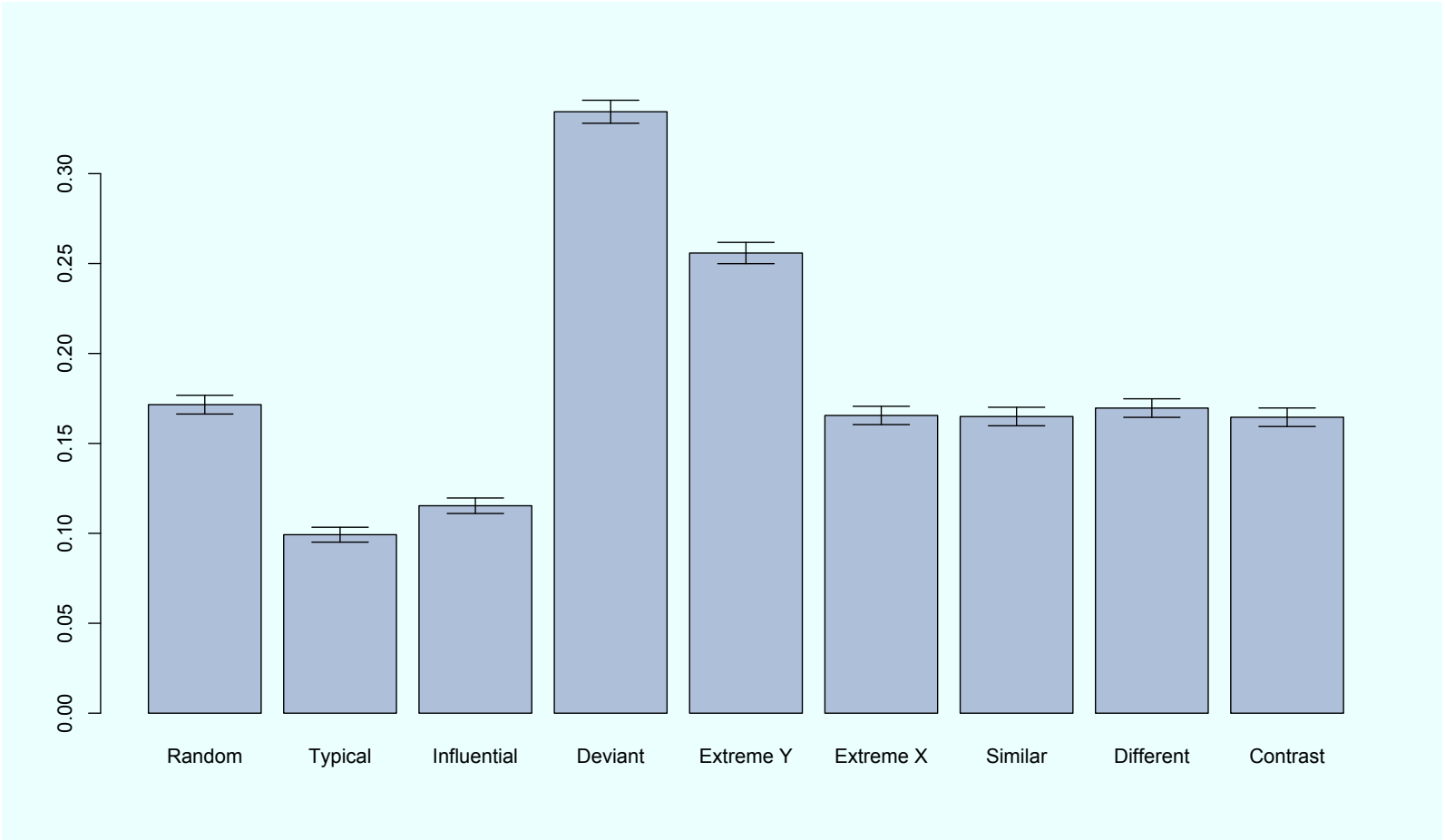

Figure: Case Selection for Other Causes.

Simulation Results

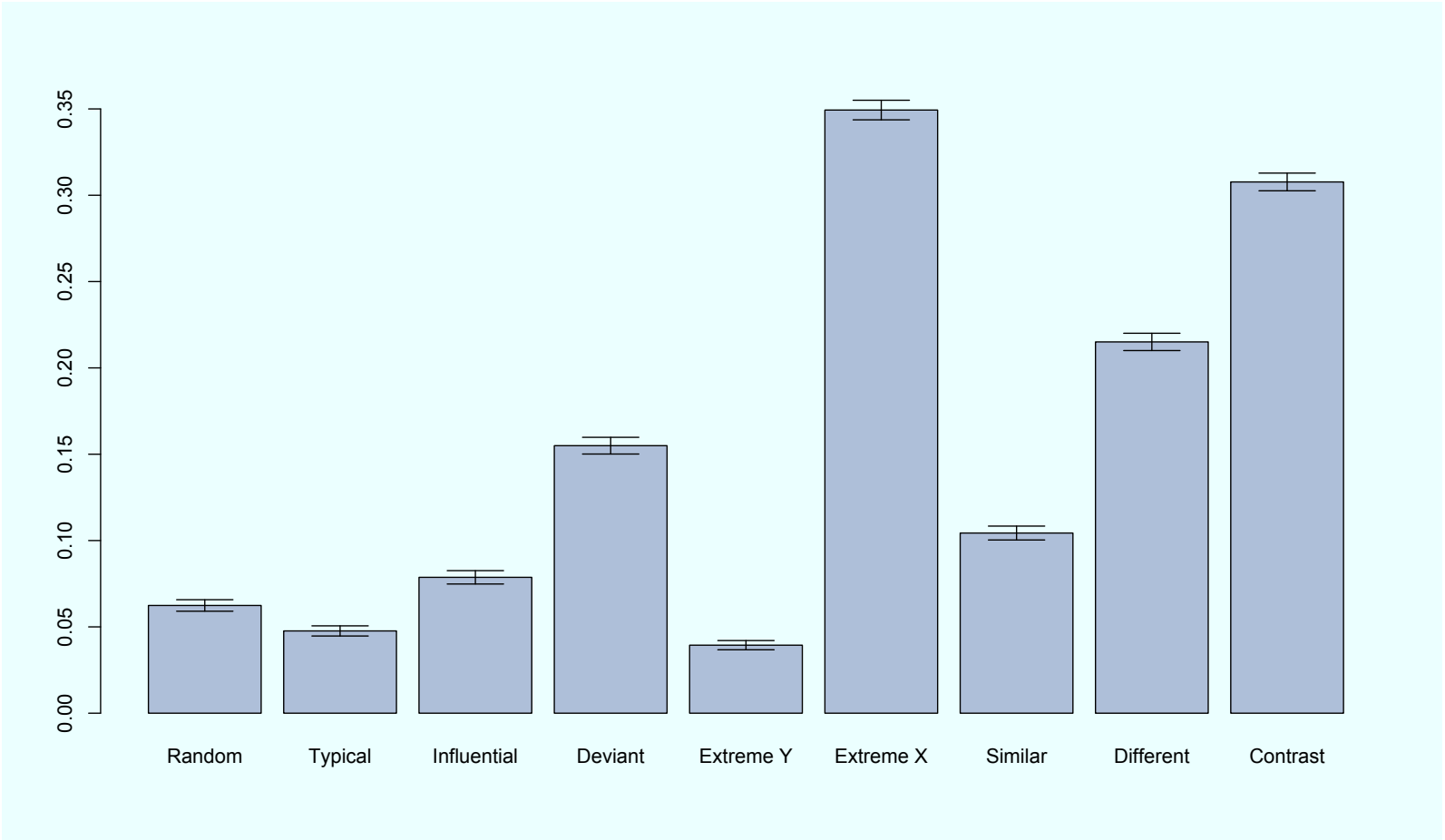

Figure: Case Selection for Exploring Mechanisms.

Simulation Results

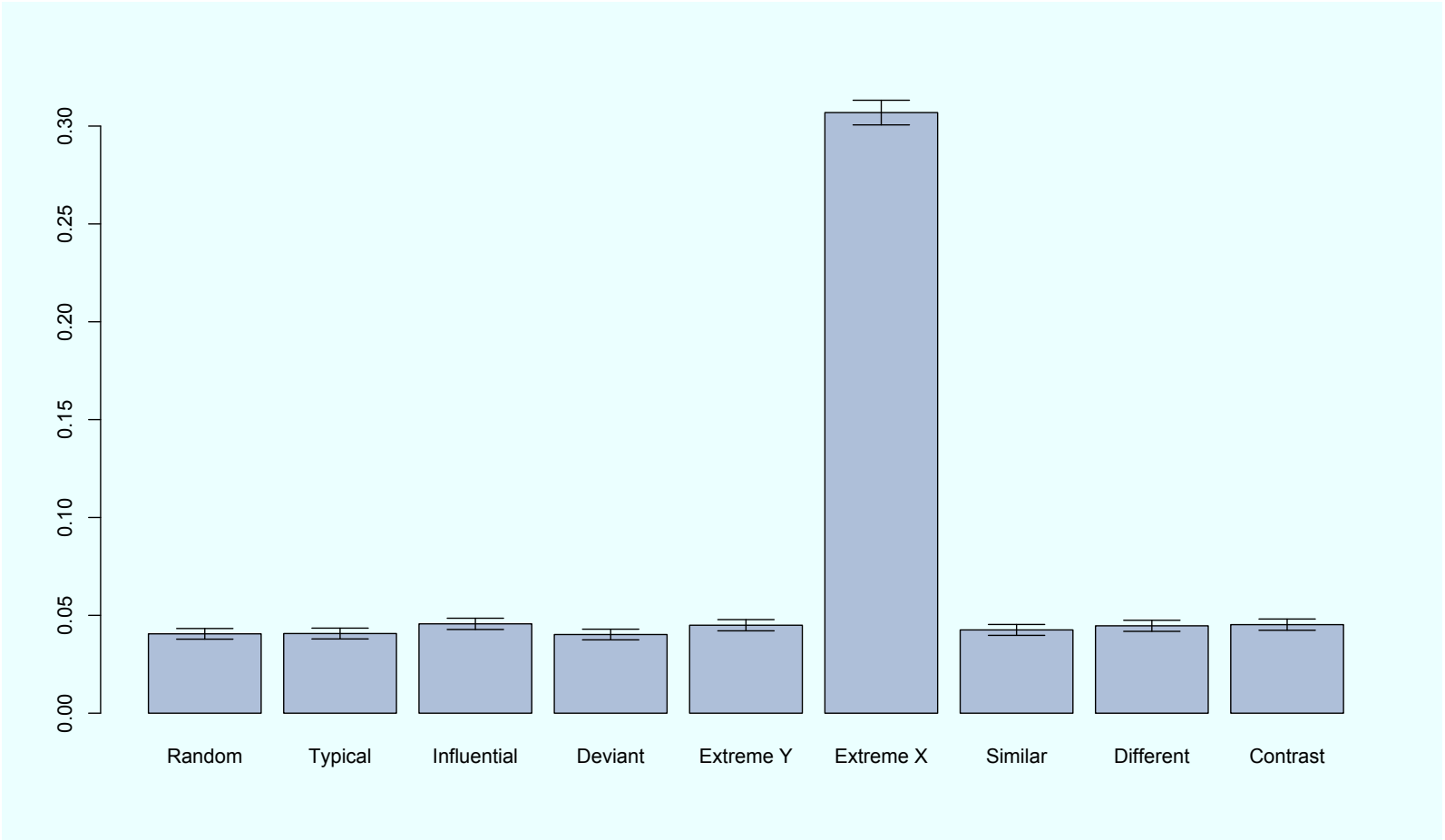

Figure: Case Selection for Error in X.

Simulation Results

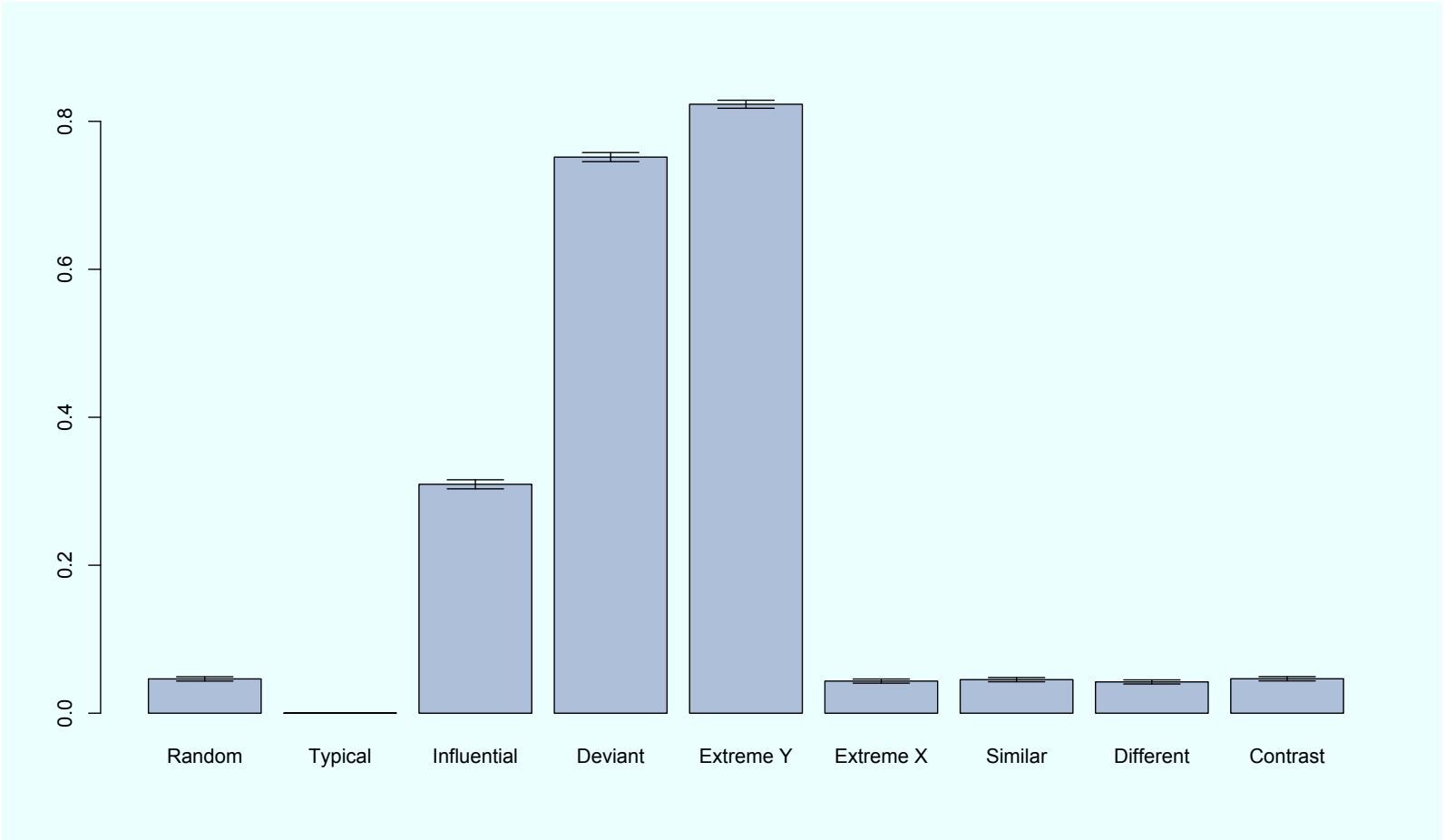

Figure: Case Selection for Error in Y.

Simulation Results

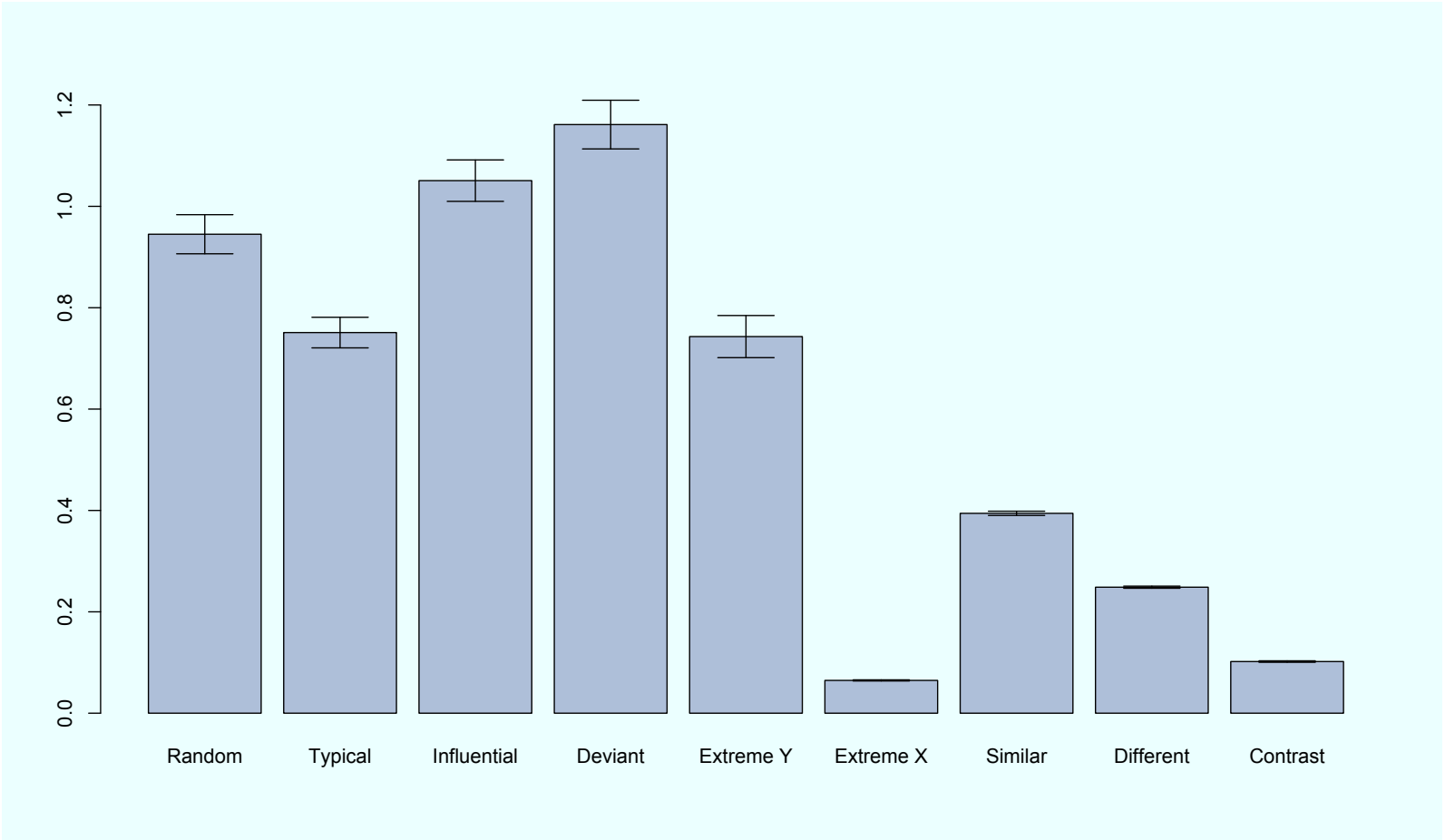

Figure: Case Selection for Estimating Overall Slope.

Case-selection software in R

Assignment

Implement each case-selection technique for a data set of interest, or off my website. Be prepared to discuss what kinds of cases you get, and whether they seem on first glance to be useful, tomorrow.